

REMARKS

The Applicants have carefully considered this application in connection with the Examiner's Action and respectfully request reconsideration of this application in view of the following remarks.

I. Rejection of Claims 1, 4-12, 15- 24 under 35 U.S.C. §103

The Examiner continues to reject Claims 1, 5-12, and 16-24 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,591,671 to Kim *et al.* ("Kim") in view of U.S. Patent No. 5,714,418 to Bai *et al.* ("Bai") and U.S. Patent No. 5,970,374 to Teo ("Teo"). The Examiner has amended his rejection of Claims 4 and 15 under 35 U.S.C. §103(a) as being unpatentable over Kim in view of Bai, Teo and further in view of the Applicant's admitted prior art ("AAPA").

The Applicants note that the Examiner's basis for rejecting Claims 1, 5-12, and 16-24 have not changed. Only the basis for rejecting Claims 5 and 15, which now also cites the Teo reference has changed.

In response to arguments made by the Applicants in their reply filed on February 12, 2004 and second appeal brief filed on June 14, 2004, the Examiner now cites Column 5, Lines 24-42 of Kim. The Examiner asserts that this section of Kim along with Bai demonstrates "that a plug with an uppermost surface extending to the surface of the substrate as recited in claim 1, can be obtained." The Examiner further states that an oxidized metal plug would not be expected if a metal not susceptible to oxidation is employed and the barrier is omitted.

The section of Kim newly cited by the Examiner describes a preferred embodiment where, after performing the process of FIG. 2D, the refractory metal layer is formed on the resultant using the method as described with respect to FIG. 2E (Column 5, Lines 24-28). Thereafter, the refractory

metal layer (reference 28 in Fig. 2E) is patterned together with a barrier layer (reference 27 in Fig 2E) and an ohmic contacting layer 26, which are laminated on an insulating layer, (reference number 24 in Fig 2E) thereby forming a metal pattern (Column 5, Lines 28-31). Kim goes on to say that if the refractory metal layer is formed from a material which is oxidized when exposed to oxygen, an insulating layer is formed on the whole surface of the resultant structure for preventing the oxidation of the barrier layer and the ohmic contacting layer (Column 5, Lines 31-36). Subsequently, a low ohmic contacting layer is formed between ohmic contacting layer and the impurity diffusion region, by heating the resulting structure using the heat treatment process as described with respect to Fig. 2E (Column, Lines 36-39).

The Applicants respectfully maintain that there is no teaching or suggestion that the metal pattern formed in this embodiment is a contact plug with an uppermost surface extending to the surface of the substrate. The Applicants submit that forming a metal pattern likely refers to the process of transferring the layout of a circuit design on to a substrate via lithographic procedures to form a pattern of metal lines above a substrate, and not the formation of a contact plug within a contact opening, the plug extending to an uppermost surface of said substrate. In addition, regardless of what the Examiner's expectations are concerning the use of metals that are not susceptible to oxidation, Kim does not teach or suggest forming a contact plug as recited in the Claims of the present application. Finally, the Applicants respectfully maintain that the issue is not what "could be obtained" from Kim and Bai, but whether or not these references teach or suggest all the claim limitations, there is suggestion or motivation to combine these references and there is a reasonable expectation of success.

As the Applicants have previously argued to the Examiner, one skilled in the art would not be motivated to incorporate Bai's removing method into Kim's removing step in the manner suggested by the Examiner, because there is no suggestion or motivation in the references themselves to support their combination, and there is not a reasonable expectation of success. The basis of this argument has already been set forth in detail in the second Appeal Brief filed June 14, 2004, and are incorporated by reference herein.

The Examiner also asserts (Page 7 Lines 91-12, of Present Office Action) that "Kim et al. is silent as to the type of heating process used, the duration of heating and the temperature used on said heating process, although is open to perform said heating at temperatures above 450°C, as mentioned above." Therefore, argues the Examiner, Kim is open to perform the heating process described in Teo. The Examiner further argues that Kim is open to perform the heating process described in Teo because Teo's heating process improves the adhesion of Teo's the barrier layer in the contact opening. Finally, the Examiner states that Kim also teaches performing the heating process in a nitrogen or argon containing atmosphere, while the claimed invention is silent as any particularities regarding the atmosphere conditions used in the annealing process.

Contrary to the Examiner's assertion, Kim is not silent about his heating process. To the contrary, Kim presents experimental data in Fig. 5 and Table 1 and Column 6, Lines 18-45) that describes the durations of heating, the temperatures used, and when the heat treatment is performed. Among the several examples given by Kim, heating beyond 550°C and for shorter than 10 minutes is never disclosed or suggested. As indicated in Table 1 of Kim, heating is done after metal layer formation. But Kim does not teach or suggest heating a contact plug, as recited in Claim 1.

Regarding the disclosure that Teo's heating process improves the adhesion of the barrier layer, the Applicants wish to point out that Teo teaching performing the RTA on the metal-free contact opening shown in Fig 3A. There is no teaching or suggestion by Teo of subjecting a contact plug to a temperature from about 600°C to about 750°C, as recited in Claim 1. And, as noted to the Examiner previously, Kim, is trying to balance the benefits of heating above 450°C to improve the interconnection properties of the ohmic contact and barrier layers (Column 1, Lines 60-62), against severe oxidation of these layers at temperatures above 500°C (Column 2, Lines 13-22). The Applicants maintain that there is no reason why one skilled in the art would be motivated to heat Kim's ohmic contact and barrier layers beyond Kim's limit of 550°C, based on Teo's teaching of performing a RTA of Ti and TiW layers in an unfilled contact opening 15, as shown in Teo's Fig.3A. Moreover, because Teo's RTA is conducted at a different point in the fabrication process than Kim's heating step, one skilled in the art would be extremely reluctant to change Kim's heating step to Teo's RTA.

Finally, regarding Kim's teaching of performing the heating process in a nitrogen or argon containing atmosphere and the silence of the claimed invention as to atmospheric conditions, the Applicants respectfully submit that this is not relevant as to whether or not Kim, Bai and Teo are properly combinable, or teach or suggest all of the elements of the claimed invention.

In summary, the combined teachings of Kim in view of Bai and Teo do not teach or suggest all elements of the present invention and are not properly combinable. This combination of references, therefore, fails to establish a *prima facie* case of obviousness with respect to independent Claim 1, as well as independent Claims 12 and 24, which contain analogous elements as Claim 1, or their respective dependent claims, under 35 U.S.C. §103(a). The Applicants therefore respectfully

request the Examiner either withdraw his rejection and allow Claims 1, 4-12, and 15-24, or allow the Applicant's arguments to heard by the Board of Patent Appeals and Interferences.

II. Conclusion

In view of the foregoing remarks, the Applicants now see all of the Claims currently pending in this application to be in condition for allowance and therefore earnestly solicit a timely Notice of Allowance for Claims 1, 4-12 and 15-24.

The Applicants request the Examiner to telephone the undersigned attorney of record at (972) 480-8800 if such would further or expedite the prosecution of the present application.

Respectfully submitted,

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